REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claims 1 and 7 to clarify that the welding tool is pressed into only the one of the members "and not into a member, of the plurality of members, adjacent said one of the members".

In addition, Applicants are adding new claims 31 and 32 to the application. Claims 31 and 32, dependent respectively on claims 1 and 7, recite that the welding tool is pressed into the one of the members, while being rotated, so as to remove surface oxide films on welding boundary surfaces of the one of the members and the member adjacent thereto. Note, for example, the paragraph bridging pages 8 and 9 of Applicants' specification.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed December 12, 2006, that is, the teachings of the U.S. patent publications to Okamoto, et al., Patent No. 6,843,405, and to Iwashita, Application Publication No. US 2001/0038028, and Japanese Patent Document No. 10-230376 (Showa), No. 2002-66760 (Nomura), and UK Patent Application No. 2,306,366 (Thomas, et al.), under the provisions of 35 USC 102 and 35 USC 103.

Initially, Applicants note with thanks the allowance of claims 10-12, 27 and 30; and the indication that claims 2, 3, 15, 16 and 23 would be allowable if set forth in independent form. Note Items 8 and 7, respectively, on page 6 of the Office Action mailed December 12, 2006. As Applicants consider the subject matter of, inter alia, claims 1 and 7 to be patentable, it is respectfully submitted that the claims objected to need not be set forth in independent form, in order to be allowed.

As for the other claims in the application, it is respectfully submitted that the references as applied by the Examiner would have neither taught nor would have suggested such a friction stir welding method for a lap joint, in which a plurality of members are lapped, as in the present claims, including wherein the welding tool is pressed into the one of the members, while being rotated, to cause friction stir to achieve welding, and wherein the welding tool has a small diameter projected part at a tip end of a shoulder, at least two of the plurality of members are of different metals from each other, and wherein the welding tool is pressed into only the one of the members and not into a member, of the plurality of members, adjacent the one of the members. See claim 1.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a friction stir welding method for a lap joint, in which a plurality of members are lapped, as in the present claims, including wherein the welding tool is pressed into one of the members, while being rotated, to cause friction stir to achieve welding, and wherein a tip end of the welding tool is semispherical in shape, at least two of the members are of different metals from each other, and the welding tool is pressed into only the one of the members and not into a member, of the plurality of members, adjacent the one of the members. See claim 7.

Furthermore, it is respectfully submitted that the applied references would have neither disclosed nor would have suggested such friction stir welding method as in the present claims, having features as discussed previously in connection with claims 1 and 7, and, additionally, wherein the method has additional features as in the dependent claims in the application, including (but not limited to) wherein an outer peripheral surface of a tip end of the shoulder of the welding tool is inclined to define an inclined surface (see claim 4; note also claim 8); and/or wherein an outer

peripheral surface of a tip end of the shoulder of the welding tool is rounded (see claim 5); and/or wherein a welding boundary surface is activated and welded by plastic flow, with the pressing causing material of the one of the members to be discharged to an outer periphery of the welding tool (see claim 6; note also claim 9); and/or wherein spot welding is performed, as in claim 13; and/or wherein the welding tool is moved in a direction of welding in a state in which the welding tool is pressed into only the one of the members (see claim 14); and/or wherein a trapezoidal member is provided on a surface of the one of the members on that side into which the welding tool is pressed, as in claim 17; and/or wherein the members respectively have a groove and projected part, with the projected part fitted into and welded to the groove, as in claim 18; and/or wherein the welding tool does not extend through an entirety of the thickness of the one of the members, as in claims 28 and 29; and/or wherein the welding tool is pressed while being rotated, so as to remove surface oxide films on welding boundary surfaces of the one of the members and the member adjacent thereto (see claims 31 and 32).

The invention as presently claimed in the above-identified application is directed to a friction stir welding method, for providing a lap joint weld.

In welding a lap joint by means of friction stir welding, it is important to remove a surface oxide film on a lapped surface, to activate a boundary surface. Therefore, it is necessary to heighten pressure of plastic flow.

Applicants accomplish such objective, e.g., of removing the surface oxide film and forming a lap joint weld, according to the present invention, used in welding members of different metals from each other, utilizing a welding tool having a small diameter projected part at a tip of a shoulder, and pressing the projected part and the shoulder of the welding tool into the one of the members, the welding tool being pressed into only the one of the members and not into an adjacent member thereto.

Through use of the welding tool as in the present invention, in the process of the present invention, plastic flow occurs toward both ends of the welding part in a state of high pressure and high temperature, and the plastic flow causes shearing stress on the welding boundary surface of the adjacent plates in the welding part, so that surface oxide films on the welding boundary surfaces are removed and both plates are mechanically welded. See the paragraph bridging pages 8 and 9 of Applicants' specification; note also page 5, lines 13-20 thereof.

As will be discussed in the following, it is respectfully submitted that the present invention is based on a different technical idea from that of the applied references, e.g., removal of the surface oxide films for providing a good metallic weld, and that teachings of the applied references would have neither disclosed nor would have suggested the present invention.

Showa discloses a method of joining mutual end parts of two plate shape metallic joining members, by providing a bent part to one of the plate shape metallic joining members. The end part of one joining member is bent in the thickness direction in parallel, and this end part of the one joining member and the end part of the other joining member are superposed so that one side surface of both joining members is arranged on the same flat surface. A rotating pin shape probe is inserted in the superposed direction from the outside of the bent part, and frictional agitation joining is applied to the superposed part.

As can be seem in the figures of Showa, it is respectfully submitted that this patent document discloses a friction stir welding technique wherein the rotating pin shape probe is inserted into both of the joining members. It is respectfully submitted that this patent document does not disclose, nor would have suggested, such method as in the present claims, including, inter alia, wherein the welding tool is pressed into only the one of the members and not into a member adjacent thereto.

In the Office Action mailed December 12, 2006, in paragraph 10 on page 7, the Examiner refers to the computer translation (which indicates that the translation "may not reflect the original precisely") as describing in paragraph 18 that the boundary surface is activated by plastic flow and discharging member material is placed behind the probe to fill the gap. Applicants respectfully traverse the contention by the Examiner that the computer translation teaches "activating the boundary surface by plastic flow". Moreover, it is respectfully submitted that this reference does not disclose, nor would have suggested, and in fact would have taught away from, such method as in the present claims, wherein the projected part and shoulder of the rotating tool is pressed into only the one of the members and not into a member, of the plurality of members, adjacent to the one of the members, as in the present claims.

In this regard, the Examiner points to the aforementioned translation paragraph 18 as teaching "that the probe is inserted through the upper material (1) to near the front face of the lower material (2)", the Examiner further contending that there is "no disclosure [of] penetration into the lower material". It is respectfully submitted that taking the teachings of this reference as a whole, including the drawing figures, it would have been clear to one of ordinary skill in the art, especially from a "precise" translation of the applied reference, that the rotating pin shape probe of the rotary tool in the friction stir welding extends into both members, and not into just one of the two members.

Okamoto, et al. discloses a method of joining metallic materials by means of a rotating probe, wherein a pit or concave is formed in a joining portion of one of the materials to be joined, and then the joining portion of another material is plasticized to generate plastic flow that enters into the pit. This patent specifically discloses that in the method described therein, the two materials are not metallurgically bonded

i.e., there is no mixing of the two materials, but the materials are joined by a so-called mechanical joining method wherein the pit of one material is filled with the other material. See column 1, lines 38-51. Note, further, column 2, lines 39, 40 and 59-61. See, further, column 3, lines 4-8 and 29-40.

It is emphasized that according to the process of Okamoto, et al., there is a mechanical connection of the two members, providing a mechanical joining method. It is respectfully submitted that the technique of Okamoto, et al. requires a relatively complex procedure including forming of the pit, as well as relatively precise location of the welding tool. It is respectfully submitted that this reference would have neither disclosed nor would have suggested, and in fact would have taught away from, such a friction stir welding method as in the present claims, including, inter alia, pressing of the welding tool into one of the members, while being rotated, to cause friction stir to achieve welding. Again, it is emphasized that Okamoto, et al. achieves a mechanical joining, not a welding, and Applicants respectfully traverse the conclusion by the Examiner that Okamoto, et al. discloses a friction stir welding method, or that welding is performed by pressing the tool into an upper member only. In this regard, note that Okamoto, et al. claims a method of joining metallic materials.

Contentions by the Examiner in connection with Okamoto, et al., in paragraph 11 on page 7 of the Office Action mailed December 12, 2006, are noted. In particular, it is noted that the Examiner points to Okamoto, et al. as teaching a method of joining material by friction using plastic flow. It is respectfully submitted, however, that the present claims recite a friction stir welding method for a lap joint, in which a plurality of members are lapped and a welding tool is pressed into one of the members while being rotated, to cause friction stir to achieve welding. It is respectfully submitted that the present claims do not merely recite "joining material

by friction using plastic flow". Properly construing the present claims, it is respectfully submitted that Okamoto, et al. would have taught away from the presently claimed method.

It is respectfully submitted that the combined teachings of Iwashita and Nomura, et al. would have neither disclosed nor would have suggested the presently claimed invention.

Iwashita discloses a method for joining plate materials made of aluminum or pressed materials, including the steps of superposing at least two materials W1, W2 (note Fig. 1), rotating a cylindrical rotary tool 1 having a projection 2 at its end portion 3 around its axis to press the end portion 3 on the first material W1 at the outermost surface, inserting the projection 2 in the material, and agitating the superposed first and second materials W1, W2 by the friction in the non-melting condition to join the materials. Note, in particular, paragraph [0035] on page 2 of this published application. Note also paragraph [0008] on page 1 of this published application. See also Fig. 6 and the corresponding description in paragraph [0049] on page 3 of this published application.

It is respectfully submitted that Iwashita does not disclose, nor would have suggested, the different materials, nor would have disclosed or suggested such process wherein the projected part and the shoulder of the welding tool are pressed into one of the members (see claim 1), or wherein a tip end of the welding tool is semispherical in shape (note claim 7), or other features of the present invention as discussed in the foregoing, including wherein the projected part/shoulder is only pressed into one of the members, and advantages thereof. In this regard, clearly the tool shown in Fig. 6 does not have a semispherical projection (or a tip end of the welding tool being semispherical in shape).

It is respectfully that the additional teachings of Nomura, et al would not have rectified the deficiencies of Iwashita, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Nomura, et al. discloses a technique to simplify a deburring process after joining of a metal member. This patent document also discloses an initial joining technique, wherein a first metal member W1 and second metal member W2 are lapped and joined by frictional agitation in a non-melted state, using a rotational member. This patent discloses that the rotational member has a crevice 3a promoting the plastic flow in the crevice. Noting especially that Nomura, et al. includes a crevice while Iwashita has a projection 2 of the rotary tool, it is respectfully submitted that one of ordinary skill in the art concerned with in Iwashita would not have looked to the teachings of Nomura, et al. It is respectfully submitted that there would have been no motivation for combining the teachings of these references.

In any event, even assuming, arguendo, that the teachings of these references were properly combinable under 35 USC 103, such combined teachings would not have rectified the deficiencies of Iwashita; and, in particular, it is respectfully submitted that the combined teachings would have neither disclosed nor would have suggested the projected part, particularly semispherical in shape, as in the present claims, and/or wherein the projected part and shoulder are pressed into one of the members, the welding tool being pressed into only the one of the members and not into a member, of the plurality of members, adjacent the one of the members, as in the present claims, and advantages thereof; and/or other features of the present invention as discussed previously, and advantages thereof.

It is respectfully submitted that the combined teachings of Showa and of Thomas, et al. would have neither disclosed nor would have suggested the presently claimed invention.

Showa, et al. has been previously discussed.

Thomas, et al. discloses a friction stir welding method, for joining workpieces defining a joint region therebetween, which comprises causing a probe of a friction stir welding tool, which is of a material harder than the workpiece material, to enter the joint region and opposed portions of the workpieces on either side of the joint region while causing relative cyclic movement between the probe and the workpieces whereby frictional heat is generated to cause the opposed portions to take up a plasticized condition; translating the probe along the joint region; removing the probe; applying pressure to the material downstream of the probe; and allowing the plasticized portions to solidify and join the workpieces together.

It is emphasized that Thomas, et al. requires the probe to enter the joint region, and opposed portions of the workpieces on either side of the joint region. Even assuming, arguendo, that the teachings of Showa and of Thomas, et al. were properly combinable, it is respectfully submitted that such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including, inter alia, wherein the welding tool is pressed into only the one of the members and not into a member, of the plurality of members, adjacent the one of the members, and advantages achieved thereby; and/or other features of the present invention as discussed previously, and advantages thereof.

It is again emphasized that the present invention provides a method wherein a welding boundary surface is activated, e.g., by removing surface oxide at the respective boundary surfaces being welded, such surface oxide being removed by a shearing stress on the welding boundary surface caused by plastic flow due to the welding tool used and location thereof. It is respectfully submitted that the teachings of the applied references do not disclose, nor would have suggested, such technical idea, nor technical as in the present claims, carrying out such technical idea.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case No. 500.45682X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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